An experiment with Mockshop investigating the effects of 3D/2D interfaces and Product Coordination display based on Color, Discount, and Brand

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Abstract

Purpose –The primary purpose of this study is to examine the effects of product display based on color, discount, and brand on retail pleasure, arousal, flow, perceived merchandise quality, time spent, satisfaction, and patronage intentions in both 3D and 2D interfaces. In so doing, this study uses the flow theory and Stimulus-Organism-Response framework to understand the effects of product display methods on consumers' emotional, cognitive, and behavioral outcomes. Nah et al. (2011) define flow as "an optimal state of experience in which one is completely absorbed in an activity that nothing else seems to matter" (p.734).

Design/methodology/approach – This study conducted a 2 (Interface: 3D and 2D) x 3 (Product coordination display: color, discount, and brand) between-subjects experimental design. Coordination of display refers to the way products are arranged based on similar properties, such as similar color, discount, or brand. All stores were designed using Mockshop, a 3D virtual software. It included a total of 144 US female consumers. Both Amazon's M-Turk and a classroom setting were used to collect the data for both 2D and 3D interfaces, respectively. After each participant provided their informed consent, they completed the self-administered online questionnaire.

Findings – The findings demonstrated that 3D interface produced higher flow, satisfaction, time spent and patronage intention than 2D interface. Also, among the six displays, participants who were in the color-coordinated store in 3D interface experienced higher levels of consumer preferences except retail pleasure and arousal (no significant effects) compared to the other displays. Sobel test, which was performed for the six

displays, confirmed that flow and perceived merchandise quality partially mediated the relationship between product display and consumers' behavioral outcomes.

Originality/value – The current study investigates product display based on color, discount, and brand in both 3D and 2D interfaces. The findings showed that color coordinated display has a strong influence on consumers' preferences. Although color coordinated display has been tested in 3D interface, it has not been compared with its effects in 2D interface such as online shopping sites. Therefore, this study fills in a gap in the literature, which can help direct retailers make the right decisions for visuals.

Table of Contents

List of Tables

List of Figures

Introduction

Statement of the problem

Currently, retailers have taken significant interest in developing a three-dimensional (3D) interface because of its highly attractive features (Brandon, 2007). Many reputable companies such as Adidas, Sony, Reuters, Cisco Systems, IBM, Dell, Mazda, Pontiac, Best buy, H & R Block, and Sun Microsystems developed a 3D interface that provides them an excellent opportunity to enhance their brand value (Nah et al., 2011). There are several possible reasons why reputable companies adopt a 3D interface. For example, Lee and Chen (2011) state that the realistic layout of a 3D interface accurately parallels the real world physical environment in consumers' mental representation. Consumers could get a tangible brand experience in a 3D interface because it mimics the consumers' engagement in a physical store (Gabisch & Webu, 2011). The behavioral consistency makes consumers more comfortable. Moreover, a 3D product presentation reduces perceived risk (Shim & Lee, 2011) because consumers could get a better idea about color, texture, and fit when the 3D virtual model is presented instead of the 2D image.

Alpcan et al. (2007) state that we are moving towards a 3D internet because we are familiar with our surroundings. On the other hand, navigation in a 2D environment is difficult because it presents a lot of information in an abstract way. Barnes (2007) as well states that a 3D environment helps consumers to engage more in a site compared to a 2D site.

Furthermore, the product placement in a 3D environment creates brand awareness

because it provides consumers virtual experiences with products (Barness & Mattson, 2008). Also, a 3D interface gives consumers an immersive brand experience because of its multimedia features. Therefore, it helps consumers to enhance their emotional, practical, and logical value towards a brand. Furthermore, a 3D product display method allows consumers to examine products from various angles (Khakimdjanova & Perk, 2005). It makes consumers more certain about a product compared to a 2D static image.

Despite some significant advantages of using a 3D site, there are also some problems that have kept consumers from using a 3D site as much as previous studies would suggest. For example, Yoon and George (2013) argue that some organizations did not get any benefit from implementing virtual worlds. Also, one of the important technology factors, compatibility, did not show significant effect on consumers in adopting 3D interfaces. Sawyerr and Hobbs (2014) suggest that consumers are reluctant in adopting a 3D interface because of the lack of usability. Usability relates to ease of use, learnability, and usefulness of the product. Viscinescu et al. (2015) empirically showed that a 2D interface creates higher perceived ease of use, perceived usefulness, and cognitive absorption (deep involvement with an interface) than a 3D interface.

Another possible important reason for not adopting a 3D interface is the cognitive overload of information (Nah et al., 2011). They explain it by using the "distraction conflict theory" noting that rich, dynamic, and multi-sensory elements of a 3D environment create cognitive overload and distract consumers' concentration. They empirically found that the 3D interface has a negative effect on the brand value (brand equity).

Currently, researchers have provided some possible solutions to reduce the usability problem and cognitive overload of consumers. Based on Kaplan's theory on the environmental preferences model, Lee and Chen (2011) state that coherence, legibility, variety, and mystery are four important dimensions that could improve the usability of a 3D interface. Coherence focuses on easy, understandable, and systematic arrangement of content that provides users a greater sense of control. Also, it increases their search behavior and reduces disorientation. Legibility is important because it facilitates better interaction and navigation in a site. Variety refers to the rich and multi-sensory elements of a 3D interface. And mystery refers to adding in components that entices consumers' exploration. Coherence and legibility influence consumers' easy perception. On the other hand, variety and mystery relate to consumers' exploration potential. Sperdin et al. (2014) empirically showed that consumers prefer an interface that is high in both ease of perception and exploration potential. Moreover, both ease of perception and exploration potential are positively related to emotional states that affects consumers' satisfaction and loyalty intentions. The importance of these four dimensions is also illustrated in Rosen and Purinton's (2004) study. Though, a 3D environment exerts mystery and complexity because of its rich, sensory, and complex environment, simplicity in design or coherence is still important to enhance the overall impression of a 3D interface. It indicates that an orderly arrangement in a 3D interface could improve the usability of that interface.

Also, an orderly arrangement in a 3D environment could reduce the cognitive overload of information (Kotabe et al., 2016). As noted by Kotabe et al. (2016), disorderly arrangement in a 3D environment leads to the loss of consumers' self-control, which creates fatigue. In addition, environmental disorder is positively associated with

social disorder (Kotabe et al., 2016).

Interestingly, Reber et al. (2004) found that consumers' interest increases if there is an orderly arrangement in a 3D environment or uniformity in variety. The processing fluency theory provides a background to understand this phenomenon. This theory states that consumers could easily process and understand the complex visual stimuli if those stimuli present symmetry and contrast-clarity. Also, Seock and Lee (2013) showed that inspirational co-ordination of items with appealing colors in the home furnishing store increases the frequency of visit. In the recent study, Jang et al. (2018) found an interaction effect between visual complexity and order for those consumers who are high in sense making. High sense making consumers most prefer the complex environment when it is highly organized.

Based on the findings from previous studies, it can be concluded that a uniformity in variety is one of the important solutions that could improve consumer usability. Moreover, by designing uniformity in variety, consumers will be less affected by the cognitive overload of information. Although prior studies discuss the importance of uniformity in variety, little empirical research has been done to differentiate which types of uniformity in a 3D environment create a higher level of preferences. However, the findings from Wu et al. (2013) are a notable exception. Using Mockshop, a 3D virtual software, the researchers created uniformity in the 3D environment by categorizing product display methods based on color, texture, and style coordination. For the color-coordinated store, similar colors such as warm color apparel items are arranged in the same row. Similarly, cool type apparel items are arranged in another row. The texture

store is coordinated based on the smoothness or thickness of apparel items. Finally, the style-coordinated store is designed based on the similar style of apparel items. This study found that people spent more money in the style-coordinated store compared to other stores. However, they showed more retailer interest and patronage intention for the color-coordinated store compared to texture and style-coordinated stores. The present study focuses on a different combination of product display methods: color, discount, and brand. Also, the effects of these three different product display methods are analyzed in both 3D and 2D interfaces.

Research purpose

This study uses the Stimulus-Organism-Response framework and flow theory to guide the development of all research hypotheses. The main objectives of this study are

a. to investigate the effects of 3D/2D interfaces on consumers' emotional state (pleasure, arousal), cognitive state (flow, perceived merchandise quality), and responses (satisfaction, time spent, and patronage intentions).
b. to investigate the effects of product display methods (color, discount, and brand) on consumers' emotional state (pleasure, arousal), cognitive state (flow, perceived merchandise quality), and responses (satisfaction, time spent, and patronage intentions)
c. to investigate the effects of six different product display methods (3D color, 3D discount, 3D brand, 2D color, 2D discount, and 2D brand) on consumers' emotional state (pleasure, arousal), cognitive state (flow, perceived merchandise quality), and responses (satisfaction, time spent, and patronage intentions).

d. to investigate the mediating roles of flow, pleasure, arousal, and perceived merchandise quality between product display methods and consumers' responses.

Significance of the study

This study applies flow theory and S-O-R framework to understand how different product display methods in the 3D and 2D interfaces influence consumer satisfaction, time spent, flow, patronage intentions, pleasure, arousal, and perceived merchandise quality. Although previous studies have discussed product coordination displays based on S-O-R, limited research has been done to investigate the effects of product coordination display on both 3D and 2D interfaces. Therefore, by using S-O-R framework and flow theory, this study will extend previous studies by comparing product-coordinated display methods based on color, discount, and brand in both 3D and 2D interfaces.

The present study will contribute to a better understanding of which product display methods produce higher flow compared to other display methods. Understanding online flow is very important because it influences various marketing outcomes such as exploratory behavior, purchase intention, addictive behavior, positive subjective experience, and perceived usefulness (Hoffman & Novak, 2009).

Moreover, this study provides marketers a better understanding of which type of product display methods need to be implemented to heighten emotional and cognitive states, and consumers' levels of preferences. A variety of selection process such as product coordination display based on fabric, category, or discount are available in

online sites such as GAP (www.gap.com) and Amazon (www.amazon.com). However, retailers still look for the most effective product coordination display methods for the 2D and 3D interfaces. Therefore, based on this study, retailers could consider implementing the most effective display method for online retailing.

Literature review

Stimulus – Organism – Response framework

S-O-R is considered an appropriate framework to understand the relationship between product display methods and consumers' responses. It was first explained by Mehrabrian and Russell (1974). They stated that environmental stimuli influence consumer behavioral responses through primary emotional responses: pleasure, arousal, and dominance. Subsequently, Donovan and Rossiter (1982) tested this model in the case of retail environment. As noted by Donovan and Rossiter (1982), store environment variables (color, store layouts, or signage) affect our emotional responses, which enhances shopping enjoyment, spending behavior, willingness to interact with sales personnel, and likelihood of returning to the store. In sum, store environment variables serve as stimuli, which influence our emotional responses. These emotional responses mediate the relationship between environmental stimuli and consumer responses.

Stimulus. Eroglu et al. (2001) define stimulus as "the sum total of all the cues that are visible and audible to the online shopper" (p.179). In the case of online context, Eroglu et al. (2001) describe two types of online environmental cues that serve the role as stimuli: high task and low task relevant cues. High task relevant cues include descriptions of the merchandise, availability of sampling, and navigation aids such as site map and guide bar at the top or bottom of the page. On the other hand, low task relevant cues contain verbal content, colors, borders, background patterns, animation, typestyles, fonts, entertainment, amount of white space, icons, image maps, and pictures.

In the case of physical environment, Baker (1986) classifies the elements of store

environment into three types: social factors, design factors, and ambient factors. Social factors include people in the store, both customers and employees. On the other hand, design factors include visual cues such as layout and color. Ambient cues include non-visual cues such as sounds, smells, and lighting.

Organism. Another important part of S-O-R is organism. Eroglu et al. (2001) define organism as "affective and cognitive intermediary states and processes that intervene the relationship between the stimulus and individual's responses" (p.180). Cognitive states refer to how consumers understand information through their own mental experiences. Affective states refer to consumers' emotional responses exerted in response to environmental stimuli. To explain these emotional responses, Mehrabrian and Russell (1974) and Donovan and Rossiter (1982) introduced the PAD model. Donovan and Rossiter (1982) define pleasure (P) as "the degree to which the person feels good, joyful, happy or satisfied with the situation" (p.38). Arousal refers to "the degree to which a person feels excited, stimulated, alert, or active in the situation" (Donovan & Rossiter, 1982, p.38). Dominance means "the degree to which a person feels excited, stimulated, alert, or active in the situation" (Donovan & Rossiter, 1982, p.38).

Baker et al. (1992) showed that consumers' emotional states, pleasure, and arousal, significantly influence willingness to buy in the store. Also, pleasure and arousal enhance perceived merchandise quality and variety, leading to unplanned time spent in the store and unplanned purchasing (Donovan et al., 1994). These emotional states are influenced by social, image, design, and ambiance cues of the retail environment (Sherman et al., 1997).

Like emotional states, consumers' cognitive states also affect consumers' responses (Eroglu et al., 2001). Eroglu et al. (2001) define cognitive state as "consumers' internal mental processes and states, and include attitudes, beliefs, attention, comprehension, memory, and knowledge" (p.181). For example, Eroglu et al. (2003) showed that online environmental cues have significant effects on both affective (pleasure and arousal) and cognitive states, which impacts satisfaction, attitude, and approach or avoidance behavior. Therefore, this study includes both affective and cognitive states as mediators.

Response. Mehrabrian and Russell (1974) classify responses into two types: approach or avoidance behavior. As noted by Demminga et al. (2012),

> Approach behaviors express a desire to stay in an environment, a desire to explore the environment, a desire to communicate with others in the environment, and the enhancement of performance or satisfaction in the environment (Mehrabian & Russell, 1974). Avoidance behaviors express a desire to get out of an environment, a desire to avoid interacting with an environment, a desire to avoid communication with others, and the hindrance of performance or satisfaction in the environment (Mehrabian& Russell, 1974). (p.111)

Subsequently, previous literature reviews documented consumer responses as money spent, patronage intentions, willingness to spend more time in the store, satisfaction, purchase intention, store loyalty, impulse buying behavior, and others. More details on this review are presented in Table 2.

Application of S-O-R in the retail environment. Applying S-O-R in the retail context, researchers investigated the effects of environmental stimuli on consumers' emotional and cognitive states, as well as consumers' responses. For example, Fiore et al. (2005) considered the level of image interactivity technology as environmental stimuli, which helps consumers to manipulate product images. The manipulation of product images enriches sensory information of products. Fiore et al. (2005) state that the image interactivity technology contributes three important determinants of telepresence (the state of being present in a real environment). These determinants are richness in sensory information, inspecting apparel products from different angles, and modification during usage. Moreover, image interactivity influences both instrumental and experiential value. It helps consumers to process more information about products. Also, it provides consumers an engaging shopping experience. Subsequently, telepresence, instrumental, and experiential value are positively associated with attitude and willingness to patronize the online retailer. Thus, the study by Fiore et al. (2005) confirmed the S-O-R links.

Based on the S-O-R framework, Jeong et al. (2008) state that product presentation features provide consumers four types of experiential experiences: educational, entertainment, escapist, and esthetic. These four types of experiential experiences influence consumers' emotions (pleasure, arousal) as well as consumer response (website patronage intention). Moreover, Wang et al. (2011) found similar results but defined environmental stimuli as aesthetic formality and aesthetic appeal. Aesthetic formality is related to classical aesthetics. On the other hand, aesthetic appeal is associated with expressive aesthetics. Classical aesthetics refer to the organization and distinctness of a website. Expressive aesthetics refer to the novelty and originality of a website. Wang et al

(2011) showed that both aesthetic formality and aesthetic appeal affect affective (satisfaction and arousal) and cognitive (perception about online service quality) states, where purchase task plays the role as a moderator. As expected, both affective and cognitive states increase the propensity to re-visit a website. This study also confirmed the S-O-R link. Some relevant literatures regarding S-O-R which is applied in the retain context are listed in Table 1.

Table 1

Key findings related to S-O-R

Reference	Stimulus variable	Organism variable	Response variable	Key findings related to SOR
Wu et al., 2013	Product display methods Color Texture Style coordination	Retailer interest Perceived merchandise quality Retail pleasure,	Money spent, and patronage intention	Product display methods have significant effects on patronage intention, perceived retail pleasure, and the amount of money spent. Color coordinated store creates higher patronage intention than texture and style coordinated store. The S-O-R link supported.
Baker et al., 2002	Social factors- store employee perceptions Design factors- store design perceptions Ambient factors- store music perceptions	Interpersonal service quality perceptions, merchandise quality perceptions, monetary price perceptions, cost and merchandise value perceptions.	Store patronage intentions	Design cues have stronger effect than social factors and ambient factors. Design cues positively affect all organism variables and response variable

				such as store patronage intentions The S-O-R link supported
Demminga et al., 2013	Lifestyle and shoppable display	Pleasure Arousal Cognitive pleasure	Approach and avoidance behavior	Both lifestyle and shoppable display positively affect pleasure, arousal, and cognitive pleasure. However, it does not have effect on approach and avoidance behavior. The S-O link supported
Kim & Johnson, 2016	Homophily and brand-related UGC	Pleasure, arousal, and perceived information quality	Information pass- along, impulse buying, future purchase intention, and brand engagement	Brand-related UGC affects pleasure, and perceived information quality. Pleasure, arousal, and perceived information quality have significant and positive effects on consumer response variables.
Kim et al., 2009	Product presentation and music	Emotional states (PAD)	Purchase intent, and attitude towards the site	Product presentation had a significant effect on consumer's cognitive, emotional and conative responses. The S-O-R link supported

Kim and Lennon, 2013	Website quality-website design, reliability, customer service, security	Emotion	Purchase intention	All four-website quality except customer service had a positive effect on emotion. Emotion has a significant effect on purchase intention The S-O-R link supported
Chang et al, 2011	Retail environmental characteristics Ambient, design and social characteristics	Positive emotional responses	Impulse buying behavior	Ambient and design characteristics of the retail environment positively affect positive emotional response. Positive emotional responses have a significant effect on impulse buying behavior. The S-O-R link supported
Hulten, 2012	Visual and olfactory cues		Shopper's touching behavior, purchase intentions, and total sale	Visual and olfactory cues have a direct and positive effect on shopper's touching behavior, purchase intentions, and total sale. The S-R link supported
Koo and Kim, 2013	Store environmental cues (ambient, design, social, and merchandise)	Store love	Store loyalty	Design and merchandising cues have positive effects on store love, which

				enhances store loyalty.
Wu and Wu, 2014	Online product presentation- Product density, model appeal, image quality, and interactivity of product presentation, website visual design and web advertising	Emotion- pleasure and arousal and cognition- ease of use and usefulness	Approach/avoidance behavior	Interactivity of product presentation and web layout have stronger effects compared to other visual merchandising cues. Pleasure mediate the relationship between interactivity of product presentation and approach/avoidance behavior. Perceived ease of use mediates the relationship between layout of the website and consumer approach/avoidance behavior. The SOR link supported

Application of S-O-R in the current research

Based on previous literature reviews and S-O-R, this study considers product display coordination based on color, brand, and discount in both 3D and 2D interfaces as environmental stimuli. This study considers the same affective and cognitive states. However, this study also includes flow as a cognitive state. The responses are satisfaction, time spent, and patronage intentions.

Flow

Nah et al. (2011) define flow as "an optimal state of experience in which one is completely absorbed in an activity that nothing else seems to matter" (p.734). Novak et al. (2000) further define flow as:

> a cognitive state experienced during navigation that is determined by (1) high levels of skill and control; (2) high levels of challenge and arousal; and (3) focused attention; and (4) is enhanced by interactivity and telepresence. Consumers who achieve flow on the web are so acutely involved in the act of online navigation that thoughts and perceptions not relevant to navigation are screened out, and the consumer focuses entirely on the interaction. (p. 22)

Previous studies suggest some important antecedents of consumer flow experience. They are interactivity, vividness, telepresence, novelty, playfulness, attractiveness, personal innovativeness, ease of use (Hoffman & Novak, 2009), challenge and skills (Mathwick & Rigdon, 2004), focused attention (Novak et al., 2000), specific goals (Novak et al., 2003), and temporal dissociation/time distortion (Novak, 1999). Some of the important outcomes of flow are addictive behavior, learning, perceived behavioral control, positive subjective experience, purchase intention, and exploratory behavior (Hoffman & Novak, 2009).

In order to highlight the characteristics that affect flow, Park et al. (2008) have developed a conceptual model of 3D VWs. These characteristics are control, content, and process. Control characteristics deal with the balance of challenge and skills. Content characteristics refers to the interactivity and vividness of 3D interface. And, process characteristics discuss consumers' intrinsic and extrinsic motivation. These three

essential characteristics of 3D VWs provide a high flow experience for consumers, which improves brand value.

Nah et al. (2010) present the importance of control characteristics (skills and challenges) of 3D VWs on flow experience empirically. The balance of power and challenges is essential to enhance consumer flow experience, which in turn improves brand equity and behavioral intention. Subsequently, Nah et al. (2011) compare brand equity and behavioral intention between 2D and 3D virtual worlds based on content characteristics (interactivity and vividness). This study suggests that 3D VWs branding sites are more interactive and vivid compared to 2D VWs branding sites. 3D VWs offer immersive and enjoyable virtual product experiences, which heightens telepresence, a specific aspect of flow. Telepresence refers to the state in which a person feels present in the physical world while using software (Steur, 1992). Both interactivity and vividness enhance increased telepresence. Vividness is associated with the clarity, concreteness, and richness of the mediated environment. Previous studies define telepresence either as a critical component or an antecedent of flow. For example, Hoffman and Novak (1996) and Novak et al. (2000) state that telepresence positively affects consumer flow experience, while Skadberg and Kimmel (2004) and Pace (2004) define telepresence as one of the essential elements of flow.

Consumer flow experience in the retail context

Focusing on all antecedents of flow, the synopsis of previous research suggests that flow theory is extensively used in the context of both 3D sites (Park et al., 2008; Choi & Baek, 2011; Nah et al., 2011; Faiola et al., 2013) and 2D sites such as online

shopping (Koufaris, 2002; Gefen et al., 2003; Korzaan, 2003; Mathwick & Rigdon, 2004; Bauer et al., 2006; Guo & Poole, 2009; Hoffman & Novak, 2009; Hausman & Siekpe, 2009; Lee & Chen, 2010; Mollen & Wilson, 2010; Nusair & Parsa, 2011).

Noort et al. (2012) argue that consumer flow experience enhances elaborate processing of information. Flow experience provides immersive shopping experiences and it encourages consumers to pay attention to the relevant information on a website. Based on the Elaboration Likelihood Model (Petty & Cacioppo, 1986), product related information is considered as a central cue. On the other hand, website design is considered as heuristics. Consumers focus more on product related information compared to website design when they experience flow. Moreover, it not only influences cognitive responses, but it also has significant, positive effects on affective (attitude toward web site and brand) and behavioral responses (referral intention, revisit, and shop intention).

Ettis (2017) has established an interesting relationship between online atmospheric color and consumer flow experience. The findings of his research showed that a cool color such as blue produces higher flow (perceived enjoyment and concentration) than a warm color such as yellow. Psychologically, cool colors induce higher pleasantness than warm colors.

Moreover, Bilgihan (2016) showed that both utilitarian and hedonic features influence consumer flow experience. However, utilitarian features have a stronger influence on flow experience compared to hedonic features. Flow experience reduces unpleasant consequences, which enhances trust towards the e-commerce website. Furthermore, consumer flow experience affects reengagement of consumers with a

website, which influences e-loyalty.

The mediating role of flow within the S-O-R framework

Previous studies suggest that flow plays the role of mediator in the S-O-R. For example, Lee and Jeong (2011) conceptually posit that ambience, design, and social factors affect flow experience, which influences consumers' emotions, satisfaction, and behaviors. Also, Hsu et al. (2012) showed that website quality such as its information system and service quality positively affect perceived playfulness and perceived flow, which influences consumer satisfaction and purchase intention. This study also confirmed the mediating role of consumer flow experience. Some other previous literature reviews regarding the mediating role of flow in the S-O-R framework are listed in Table 2.

Table 2

The mediating role of flow in the S-O-R framework

Reference	Stimulus variable	Organism variable	Response variable	The mediating role of flow in the S-O-R framework
Liu et al. (2016)	Perceived expertise, perceived similarity, and perceived familiarity	Flow experience	Purchase intention	Perceived expertise, perceived similarity, and perceived familiarity are positively related to flow experience. Flow experience influences purchase intention. This study confirmed that flow mediates the relationship between perceived expertise, perceived similarity, perceived familiarity, and purchase intention.
Gao & Bai (2014)	Website atmospheric cues: informativeness, effectiveness, entertainment	Flow	Purchase intention, and satisfaction	Websites atmospheric cues such as infromativeness, effectiveness, and entertainment positively affect flow, and flow influences purchase intention and satisfaction. This study also confirmed that flow plays the role as a mediator.
Animesh et al. (2011)	Technological (interactivity, sociability), spatial (density, stability)	Telepresence, flow, social presence	Intention to purchase	Interactivity, density, and stability are positively related to flow. Telepresence and

				social presence also influence flow. Flow positively affects intention to purchase.
Hoffman & Novak (2000)	Interactivity, skill, challenge, focused attention, telepresence	Flow	Exploratory behaviors	Interactivity, skill, challenge, focused attention, and telepresence are positively related to flow. Flow influences consumers' exploratory behaviors.

Product coordination display

Product coordination refers to the way products are arranged based on similar properties such as similar color, texture, or style (Wu et al., 2013). Damminga et al. (2013) coordinate apparel products based on lifestyle and shoppability. This study categorizes apparel products based on similar color, discount, and brand.

Bell et al. (1991) showed that when products of similar aesthetic quality are grouped together rather than individually, it influences perceived unity. Unity is one of the design principles which positively affects aesthetics or beauty (Veryzer & Hutchinson, 1998). For example, most physical stores coordinate their products based on product category. This format helps consumers to easily choose their desired products (Veryzer & Hutchinson, 1998). Using a semi-structured interview with a small sample of female undergraduate students, Kerfoot et al. (2003) found that color coordination of displays influence consumers' preferences, their perceptions of merchandise quality, and their intention to browse in the store. Also, Yoo and Kim's (2012) experimental study

confirmed consumers' liking for product coordination display rather than uncoordinated display. Coordination of products creates a visual harmony, which enhances consumers' pleasing experience. Also, order and clear design in a rich environment is highly correlated with usability (Lavie & Tractinsky, 2004). Currently, retailers not only focus on visual aesthetics, but they are also highly concerned with usability (Moshagen & Thielsch, 2010).

Coordination not only influences aesthetics and usability, but it also increases social impression of products (Lam & Mukherjee, 2005). Based on Elaboration Likelihood Model, Lam & Mukherjee (2005) state that consumers use aesthetics as a central cue and social impression as a peripheral cue to evaluate complementary products (i.e. shirts and pants) when they are juxtaposed. The present research discusses product display methods related to color, discount, and brand.

Product Display related to Color

Color, an atmospheric cue, plays an important role in the retail environment (Belllizzi, 1983; Eroglu & Malceit, 1993; Turley & Milliman, 2000). Using the Stimulus-Organism-Response, Eroglu et al. (2001) conceptualized how color impacts both affective and cognitive states, as well as shopping outcomes. Currently, Roschk et al. (2017) conducted a meta-analysis (from the previous 30 years) to examine the effects of color on consumers' responses. The results showed that color type, such as warm or cool color, influences consumers' pleasure, arousal, satisfaction, and behavioral intentions. Furthermore, online environment cues such as color and layout directly affect shopping enjoyment, shopping involvement, and desire to stay at an online store (Kim et al., 2007).

Additionally, color has also been explained as a component of product display method (Lam & Mukherjee, 2005; Wu et al., 2013). As noted by Lam & Mukerjee (2005), merchandise products that are coordinated based on color, style, or design may enhance brand image and affect shopping behavior, shopping experience, and shopping outcomes. Subsequently, Wu et al. (2013) conducted experimental research to compare among three types of product coordination display methods based on color, texture, and style. Color-coordinated store showed significantly higher patronage intention and retail pleasure compared to the texture and style coordinated store. Furthermore, the Kim et al. (2017) study presented an interesting finding regarding product information, which is displayed based on color. They showed that product information presented in different color has significant effects on "compromise effect." If products are presented with different colors, consumers rely on heuristics to process the information. However, it is difficult for them to reach a decision, ultimately choosing the middle option which is called compromise effect. On the other hand, if products are presented with the same type of color, consumers do not have difficulty in choosing products. Moreover, McIlnay et al. (2017) found that a dark product is preferred more when the background is bright. When the brightness level contrasts with the background environment, they visually "pop out" (for example, light products in a dark environment or dark products in a bright environment) and this increases consumers' preferences towards products.

From the above studies, it is clear that color impacts consumers' perceptions. If apparel products in a store are coordinated based on warm, cool, neutral, and mix colors, it will influence consumers cognitive, affective, and behavioral outcomes. Some previous literature reviews regarding environmental color are listed in Table 3.

Table 3

Color in in-store environment research

Reference	Explanatory variables	Response variables	Results	Method
Bellizzi and Hite, 1992	Display (red and blue)	Purchase rate and shopping time	Blue retail environment produces more pleasurable feelings than the red environment. Shopping time is longer in the red display condition rather than the blue condition.	2 x 2 experimental design (purchase/postponement; red display/blue display)
Bellizzi et al. 1983	Color	Approach orientation, physical attraction, consumer perceptions of the store environment and merchandise	Color affects approach orientation, physical attraction, and consumer perceptions of the store environment and merchandise	Experimental
Babin et al. (2003)	Color, lights, and perceived price fairness	Evaluations, patronage and purchase intentions	Blue interiors generate more favorable evaluations, higher patronage, and purchase intentions than orange interiors.	2 (color: orange vs. blue) x 2 (lights: bright vs. soft) x 2 item price (US$59.95 vs. US$149.95)
Mehta and Zhu (2009)	Color (red and blue)	Creative task performance	Red improves performance on a detail-oriented task and blue improves performance on a creative task.	2 (color: red and blue) x2(task: performance and creative)

Product Display related to Discount

Discount plays an important role in influencing consumers' product evaluation and purchase intention (Grewal et al., 1998; Nusair et al., 2010). As noted by Grewal et al. (1998), when retailers offer a higher discount, it reduces consumers' perceived quality of products. Furthermore, price discount significantly influences consumer price perceptions (Stanfort et al., 2001). Also, Nusair et al. (2010) showed that different discount levels significantly influence the value of the discount, the quality of the service, the purchase intentions, the willingness to engage in the word of mouth advertising, and the overall evaluation of the discount. The researchers described two types of discount frame: dollar off and percentage off. The "Dollar off" discount frame enhances the consumers' intent to make a purchase. On the other hand, the "Percentage off" discount frame heightens service quality and intention to spread WOM advertising. Furthermore, Stanfort et al. (2011) found that consumers' price perceptions about products are lower when retailers offer a discount rather than product incentives with purchase.

Previous studies also examined discounts as a component of product display method (Kim & Kramer, 2006; Feng et al., 2017). For example, Kim and Kramer (2006) compare two types of discount presentation such as telling consumers they will pay 80% of the total retail price or 20% of the original retail price. By presenting consumers with 80% of pricing of the original, the presented discount increases the perception of savings and purchase likelihood compared to presenting customers with 20% off the original price. As noted by Kim and Kramer (2006), pay 80 percent is a novel presentation, whereas, take 20 percent off is a typical presentation. Novel presentation format increases

systematic processing of information, which helps consumers to improve the calculation accuracy. Also, currently, Feng et al. (2017) showed that consumers take less time to compute the monetary discount when price promotions with discounts are presented vertically rather than horizontally. Vertical presentation format refers to when the regular price of products is presented vertically, while horizontal presentation format means when the regular price of products is placed from the left to right or vice-versa. Horizontal presentation format induces complexity in information processing and exerts math anxiety because it only relies on verbal memory resources. On the other hand, vertical presentation format relies on visual-spatial resources, which increases the ease of information processing.

Based on previous studies, it is apparent that discount plays an important role in influencing consumers' perceptions. If products are displayed based on discounts in the retail environment, it may increase their shopping behavior because of their perception of savings.

Product Display related to Brand

A synopsis of prior research suggests that the image of the retail environment influences consumers' perceptions of brands (Dolebc & Chhebat, 2013; Damminga et al., 2013; Foster & Mclelland, 2015). For example, Dolbec and Chebat (2013) show that flagship stores create a better brand experience than brand stores for the same type of brand. Flagship stores provide highly interactive, emotional, and sensory elements than brand stores. Foster and Mclelland (2015) state that retailers need to present theme-dictated display over merchandise-focused display to enhance brand differentiation,

brand loyalty, and shopping enjoyment.

Furthermore, brand has also been explained as a component of product display method (Simonson & Winner, 1992; Buchanan et al., 1999; Pullig et al., 2006; Berger et al., 2007). As noted by Pullig et al. (2006), when a newly introduced brand is displayed with existing brands, this mix significantly influences consumers' responses. For example, if the new brand's attributes in a category are dissimilar to the existing brands, this dilutes the brand. On the other hand, the brand is not diluted if the new brand and existing brand show similar attributes. Also, brand variety plays an important role in influencing consumers' brand evaluations and choices (Berger et al., 2007). As stated by Berger et al. (2007), a variety of brands serves as a quality cue. Using six experimental studies, they show that consumers' brand evaluations and brand choices are higher when brands are presented with the large number of competing brands.

In addition to this, brand influences the perception of status (Nelissen & Meijers, 2011). By using an experimental study, Nellison and Meijers (2011) compare s luxury label with a no label product and found that when a person wears a shirt with a luxury label, it increases their status. According to costly signaling theory, wearing a luxury label is considered a signal of wealth, which will enhance preferable social interactions with other consumers.

Based on previous studies, it is notable that if product selection is coordinated based on different brands, this will significantly influence consumers' perceptions.

Based on this literature review, flow theory, and the SOR the hypotheses are

H1: Both 3D and 2D interfaces have a significant effect on subjects' (a) flow, (b) pleasure, (c) arousal, (d) perceived merchandise quality, (e) satisfaction, (f) time spent, and (g) patronage intentions.

H2: Product display methods based on color, discount, and brand have a significant effect on subjects' (a) flow, (b) pleasure, (c) arousal, (d) perceived merchandise quality, (e) satisfaction, (f) time spent, and (g) patronage intentions.

H3: Six different product display methods (3D Color, 2D Color, 3D Brand, 2D Brand, 3D Discount, and 2D Discount) have a significant effect on subjects' (a) flow, (b) pleasure, (c) arousal, (d) perceived merchandise quality, (e) satisfaction, (f) time spent, and (g) patronage intentions.

H4: Subjects' (a) flow, (b) pleasure, (c) arousal, (d) perceived merchandise quality mediate the relationships between the product display methods and subjects' (e) satisfaction, (f) time spent, and (g) patronage intentions.

Characteristics of 3D interface versus 2D interface

One of the fundamental differences between 3D and 2D interface is telepresence (Nah et al., 2011). As noted by Nah et al. (2011, p.735), "users who perceive a sense of telepresence are focused on virtual or mediated environment to the extent that their stimulus field is limited to just that environment, while the physical environment is disregarded". 3D environments contain dynamic and multisensory elements. These dynamic and multisensory elements evoke a sense of being a presence in the environment, which enhances telepresence. Goel et al. (2011) state that the visual and

dynamic elements in 3D environments help consumers to create social, task, and location awareness. These awareness states contribute to the formation of place attachment within 3D environment. Moreover, these three awareness states heighten cognitive absorption (deep involvement with the software), which influences the desire to return to the virtual world.

Bulu (2012) states that 3D environments produce a spatial distribution of information regarding product, texture, motion, and other details. These spatial distribution of information increase consumers' sense of presence in those environment. More recently, Vonkeman et al. (2017) discuss how the sense of presence influences consumers' impulsive buying behavior. They compare the difference between a virtual mirror and a static image. As noted by, Vonkeman et al. (2017), the 3D virtual mirror provides the possibility for consumers to try on their chosen products, which reduces their psychological distance. On the other hand, one of the important problems of 2D static images is that consumers are not able to have the sense of touching a product. Therefore, 3D virtual mirrors exert higher local presence and product affect than 2D static images, and this influences consumers' impulsive buying behavior.

Another important characteristic of 3D virtual worlds is thier affordances (Park et al., 2009). These provides navigation aids, view in view maps, animation guides, and human system collaboration. Also, customization of virtual versions increases the interactivity of product presentation (Park et al., 2008). Moreover, 3D virtual worlds provide spatial 3D products, avatars, multimedia features, and haptic feedback.

Park et al. (2005) state that 3D product movement increases consumers'

confidence to reduce their perceived risk. Also, it increases consumers' intentions to purchase a product. Besides, 3D rotation, multisensory channels, richness, and multimedia features help consumers to engage in systematic information processing (Jiang & Benbasat, 2008).

Another significant advantage of using 3D interfaces is their visualization features (Ives & Junglas, 2008). 3D interfaces allow consumers to create their own virtual environments (Nah et al., 2010). Wu et al.'s (2015) study introduces three important facets of 3D virtual environment: merchandise presentation (fixturing, product density, manner of presentation, and product adjacency), instore environment (layout and interior), and in-store promotion (signage). Based on these three important facets, this study provides three practical insights regarding the 3D environment. They are: (a) retailers need to develop an ecological environment rather than the utilitarian environment, (b) retailers should present a clear section identity, which increases consumers' sense of ownership, (c) retailers need to present lifestyle displays rather than the merchandise solutions.

In addition, the digital representation of the user, called the Avatar, is one of the most attractive and interactive features of 3D interfaces (Park et al., 2008). Users could communicate with their avatar in the 3D environment, which increases consumers' co-presence and social presence (Bulu, 2012). Additionally, an avatar is helpful in designing an excellent educational environment (Bredl et al., 2015). As noted by Bredl (2015), students get an immersive and engaging educational experience when they learn lessons interacting with avatars in a 3D environment. Also, the presence of an avatar increases

social support, which helps older consumers to reduce their technological anxiety. (Chattaraman et al., 2014).

Thus, I hypothesized:

H5: The 3D interface creates higher (a) flow, (b) pleasure, (c) arousal, (d) perceived merchandise quality, (e) satisfaction, (f) time spent, and (g) patronage intentions than the 2D interface

Methodology

The methodology section of this research study includes research design, instruments, sample, questionnaire administration, data collection, and data analysis.

Experimental design

This research conducted a 2 (Interface: 2D vs. 3D) x 3(Product display: Color, discount, and brand) between-subjects experimental design. Six stimuli were developed to conduct this study. They were: 3D color store, 2D color store, 3D brand store, 2D brand store, 3D discount store, and 2D discount store. This study adopted experimental design because it establishes the cause and effect relationship between product display methods and consumer emotional, cognitive, and behavioral outcomes.

Instruments

Experimental stimuli

Mockshop software was used to develop a 3D interface of three different product display methods based on color, discount, and brand. Mockshop is a 3D virtual software through which one can easily drag and drop fixtures and products to create an interactive 3D store. (Damminga et al., 2012). On the other hand, a 2D interface of three different

product display methods based on color, discount, and brand were designed based on actual online retailing websites such as GAP or Forever 21.

To develop both 3D and 2D product display methods, the following guidelines were implemented:

a. All six product display methods did not contain any brand information.
b. 3D color, 3D brand, and 3D discount product display methods were the same in size (35”x30”x15”). Also, 2D color, 2D brand, and 2D discount product display methods were the same in their size (35”x30”).
c. The brightness level, fixtures, background color, floor materials, and other variables were kept constant for 3D color, 3D brand, and 3D discount display methods. Both 3D and 2D interfaces contained the same type and similar number of apparel items.
d. 48 women’s apparel items of formal, basic, casual, and sportswear categories were included in all product display methods.
e. To develop the 3D and 2D color display methods, apparel items were coordinated based on warmness, coolness, neutral, and a mix of warmness and coolness of color. For the 3D color display method, warm color apparel items were arranged on the left side of the store. On the other hand, cool color apparel items were coordinated on the right side of the store. Mixed (warm and cool) apparel items occupied the back of the store. Finally, neutral type apparel items were displayed in the front of the store. For the 2D color display method, warm color apparel items were first grouped side-by-side. Subsequently, cool, mixed, and neutral colored apparel items were grouped side by side.

f. Apparel items were coordinated based on brands A, B, C, and D to develop the 3D and 2D brand display methods. Like the 3D and 2D color display methods, the same procedures were followed to design the 3D and 2D brand display methods.

g. Apparel items were coordinated based on 10 % off, new arrivals, 30% off, and 50% off to develop the 3D and 2D discount display methods. Like the 3D and 2D color display methods, the same procedures were also followed to design the 3D and 2D brand display methods.

h. All figures for product coordination display methods based on color, discount, and brand are included in the Appendix section

Data collection procedure and sample

This study focused on only female consumers because only female apparel items were chosen. A total of 144 US female consumers participated in this study. From them, 60 female undergraduate students from a mid-Western university evaluated 3D product display methods based on color, discount, and brand. They were requested to come to room 305 McNeal Hall to participate in this study because Mockshop software was only available at that room. After their arrival, the researcher provided them with some basic training on how to navigate the Mockshop software. At that moment, they successfully learned how to walk through the virtual store and reviewed product information. Lastly, all participants confirmed that they did not feel any challenges while using this software.

After their confirmation, participants were randomly assigned to one of the three stimuli. First they provided their informed consent, and then they were instructed to observe the assigned visual store. They were requested to shop and buy apparel items for themselves or for a friend who was a college women. Also, they tracked the start and end

times of their shopping in the visual store. After that, they began to fill out the online questionnaire. This interactive process took approximately fifteen minutes including the practice session. For their participation, participants were awarded 5 points extra credit for their design course.

The remaining eighty-four undergraduate female students from various US universities were recruited through Amazon M-Turk to evaluate 2D product display methods based on discount, color, and brand. After providing their informed consent, participants were asked to indicate their age and education level. The screening process confirmed that only college women participated in this study. They were randomly assigned to each stimulus. After that, they filled out all questionnaires based on their observation of the assigned stimulus. Each participant was awarded 1 USD for their participation.

Instrumentation

Pleasure

The pleasure instrument was adopted from the Donovan and Rossiter (1982) study. This instrument included seven items such as contended-depressed, happy-unhappy, satisfied-unsatisfied, pleased-annoyed, relaxed-bored, free-restricted and hopeful-despairing. The reported Cronbach's alpha was 0.87.

Arousal

The arousal instrument was also derived from the Donovan and Rossiter (1982) study. Like the pleasure instrument, this instrument included seven items, with a Cronbach's alpha of 0.87. It included items such as stimulated-relaxed, excited- calm, jittery-dull, and wide awake-sleepy.

Flow

The consumer flow experience was measured by adopting an instrument from the Novak et al. (2000) study. This instrument comprised of three items: "When carrying the virtual tour, I experienced flow at some point," "I felt I was in flow during some parts of the virtual tour," and "I did not experience any flow during my virtual tour." These items have been modified to some extent such as "when visiting the visual store, I experienced flow at some point,", "I felt I was in flow during some parts of the visual store", and "I did not experience any flow in the visual store".

Satisfaction

The satisfaction instrument was adopted from the Magi (2003) study. This instrument comprised of two items: "How satisfied are you with your primary grocery store (very dissatisfied- very satisfied)?" and "How well does your primary grocery store match your expectations (not at all-completely)?" These items have been modified to some extent such as "How satisfied are you with the visual store (very dissatisfied–very satisfied)?" and "How well does the visual store match your expectations (not at all-completely)?"

Patronage intentions

The patronage intention instrument was adopted from the Baker et al. (2002) study. It included three items with a Cronbach's alpha of 0.84 to 0.88. They were "The likelihood that I would shop in this store is high," and "I would be willing to buy gifts at this store."

Perceived merchandise quality

The perceived merchandise quality instrument was adopted from the Baker et al. (2002) study. This instrument comprised of two items: "This store offers high-quality

gifts," and "The products in this store have high workmanship." The reported Cronbach's alpha was

Manipulation check

Three single items were used for the manipulation check of each stimulus: (a) this visual product display was coordinated based on a brand of the apparel products; (b) this visual product display was coordinated based on price discount of the apparel products; and (c) this visual product display was coordinated based on the color of the apparel products.

All items for all seven instruments were measured using a 7-point Likert scale (strongly disagree to agree strongly). Five graduate students were requested to test the questionnaire and experimental stimuli. Minor adjustments were made to improve the clarity of the questions based on their suggestions.

Results

Preliminary data analysis

Cronbach's alpha was used to measure the reliability of all measurement scales. The accepted value for Cronbach's alpha is 0.7 (Kline, 1999). All items showed high reliability and the value was above 0.8. Table 1 provided detailed reliability information for each item.

Table 4

Reliability check

Item	Number of items	Cronbach's alpha
Pleasure	7	0.93
Arousal	7	0.87
Flow	3	0.93
Perceived merchandise quality	2	0.88
Satisfaction	3	0.92
Patronage intention	3	0.96

Sample characteristics

This study included a total of 144 US undergraduate female consumers. The age of female consumers ranged from 18 to 23. Most of the participants' majors were Retail Merchandising (4), followed by Business, Communications and Advertising (26 percent), Apparel Design (18 percent). Table 2 provided detailed information about sample characteristics.

Table 5

Sample Characteristics

Characteristic	Frequency	Percent
Gender		
Female	144	100%
Age		
18-23	144	100%
Major		
Retail merchandising	66	46%
Apparel Design	25	18%
Business, Communication and Advertising	37	26%
Others	16	10%

Manipulation check

Three single items were used to assess whether consumers perceived differences in product coordination display based on color, discount, and brand. MANOVA analysis showed that participants noted significant differences in color (3D interface) ($F = 26.72$, $p < 0.001$), discount (3D interface) ($F = 22.63$, $p < 0.001$), brand (3D interface) ($F = 23.47$, $p < 0.001$), color (2D interface) ($F = 32.34$, $p < 0.001$), discount (2D interface) ($F = 18.87$, $p < 0.001$), and brand (2D interface) ($F= 21.34$, $p < 0.001$).

Homogeneity assumption test

The assumption of homogeneous expression—an important feature of Levene's test—for all dependent variables with respect to six different product display methods met ($p > 0.05$) except pleasure and arousal. Therefore, I employed Pillai's trace instead to investigate the results of my test (Field, 2005). A MANOVA was conducted to understand the effects of six different display methods on all dependent variables. Results from Pillai's trace showed that the six different product display methods had significant effects on all dependent variables (v =.402, F=1.697, $p < 0.05$).

Hypothesis testing

Hypotheses 1. Comparison between the 3D and 2D interface

A between-subjects MANOVA showed that 3D and 2D interfaces have significant effects on flow, satisfaction, time spent, and patronage intentions, However, 3D and 2D interfaces do not have significant effects on pleasure, arousal, and perceived merchandise quality. Therefore, hypotheses 1a, 1e, 1f, and 1g were supported. However, 1b, 1c, and 1d were not supported. Table 6 provided detail information about the effect of 3D/2D interfaces on response variables.

Table 6

The effect of 3D/2D interfaces on response variables

Response variables		F	R^2	p
MANOVA	Flow	6.66	0.05	$p < 0.05^*$
	Satisfaction	7.63	0.05	$p < 0.05^*$
	Time spent	10.02	0.07	$p < 0.05^*$
	Patronage intentions	7.67	0.05	$p < 0.05^*$

Pleasure	$p > 0.05$
Arousal	$p > 0.05$
Perceived merchandise quality	$p > 0.05$

Hypotheses 5

Fitted regression models showed that the 3D interface creates higher flow (co-efficient= 0.06^{*}, $p< 0.05$), time spent (co-efficient = 0.07^{**}, $p < 0.05$), satisfaction (co-efficient = 0.07^{**}, $p < 0.05$), and patronage intentions (co-efficient = 0.07^{**}, $p < 0.05$) than the 2D interface. Therefore, hypotheses 5a, 5e, 5f, and 5g were supported. However, hypotheses 5b, 5c, and 5d were not supported.

Hypotheses 2. Comparison among color, discount, and brand coordination display

A between-subjects MANOVA showed that product display based on color, discount and brand has significant and positive effects on flow, patronage intention, perceived merchandise quality, and time spent. Therefore, hypotheses 2 were partially supported. Table four provided detail information about the effect of color, discount, and brand coordination display on response variables.

Table 7

The effect of color, discount, and brand coordination display on response variables

Response variables		F	R^2	p
MANOVA	Flow	4.27	0.06	$p < 0.05^*$
	Satisfaction			$p>0.05$
	Time spent	4.49	0.05	$p < 0.05^*$
	Patronage intentions	3.49	0.05	$p < 0.05^*$

Post hoc Dunett t (two-tailed) test demonstrated that product display based on color creates higher flow (*MD* = 1.07, $p<0.05$), satisfaction (*MD* = 0.74, $p<0.05$), perceived merchandise quality (*MD* = 1.2, $p <0.01$), patronage intention (*MD* = 0.88, $p <0.05$), and time spent (*MD* = 1.06, $p <0.01$) than product display based on discount. Also, this test marginally showed that consumers perceived higher perceived merchandise quality in color coordinated store than brand coordinated store *(MD* = 0.62, $p = 0.058$). Table 8 provided detail description to compare among color, discount and brand coordination displays.

Table 8

Comparison among color, discount, and brand coordination displays through post hoc Dunett t test

Response variables	*MD*	*p*
Flow		
Color/Discount	1.07	$p < 0.05^{*}$
Color/Brand		$p > 0.05$
Brand/Discount		$p > 0.05$
Satisfaction		
Color/Discount	0.74	$p < 0.05^{*}$
Color/Brand		$p > 0.05$
Brand/Discount		$p > 0.05$
Time spent		
Color/discount	1.06	$p < 0.05^{*}$
Color/Brand		$p > 0.05$
Brand/Discount		$p > 0.05$
Patronage intentions		
Color/Discount	0.88	$p < 0.05^{*}$
Color/Brand		$p > 0.05$
Brand/Discount		$p > 0.05$

Hypotheses 3. Comparison among six different product displays

A between-subjects MANOVA showed that six different product displays have significant and positive effects on flow, satisfaction, perceived merchandise quality, time spent, and patronage intentions. Thus, hypotheses three were partially supported.

Table 9

The effect of six different product display methods on response variables

Response variables		*F*	R^2	*p*
MANOVA	Flow	3.753	0.05	$p < 0.05^*$
	Satisfaction	2.83	0.045	$p < 0.05^*$
	Time spent	4.42	0.06	$p < 0.05^*$
	Patronage intentions	3.594	0.05	$p < 0.05^*$

Post hoc Dunett t (two-tailed) test demonstrated that 3D color creates higher flow than 2D brand and 2D color. 3D color creates higher perceived merchandise quality than 2D discount and 2D brand. Participants perceive lower perceived merchandise quality in 2D discount than 3D color and 3D brand. Also, 2D color, 3D color, 3D discount, and 3D brand create higher patronage intention than 2D discount. Moreover, consumers perceive higher satisfaction in 3D color, 2D color, and 3D brand than 2D discount display. 2D color creates higher flow (marginally) and time spent than 2D discount. Also, 3D color, 3D price, and 3D brand create higher flow than 2D discount. Further, 3D color creates higher arousal than 2D discount. Marginally, consumers spent more time in 3D color than 2D brand. Table seven provided detail

description about the effect of six different product display methods on response variables.

Table 10

Comparison among six different product display methods on response variables

Response variables	*MD*	*p*
Flow		
3D Color/2D Brand	1.64	$p < 0.05^{*}$
3D Color/2D Color	2.17	$p < 0.05^{*}$
3D Color/2D Discount	2.04	$p < 0.05^{*}$
3D Discount/2D Discount	1.38	$p < 0.05^{*}$
3D Brand/2D Discount	1.58	$p < 0.05^{*}$
2D Color/2D Discount	1.36	$p = 0.056$
Satisfaction		
3D Color/2D Discount	1.44	$p < 0.05^{*}$
2DColor/2D Discount	0.93	$p < 0.05^{*}$
3D Brand/2DDiscount	1.29	$p < 0.05^{*}$
Time spent		
3D Color/2D Brand	1.36	$p < 0.05^{*}$
2D Color/2D Discount	1.40	$p < 0.05^{*}$
Patronage intentions		
2D Color/ 2D Discount	1.24	$p < 0.05^{*}$
3D Color/2D Discount	1.51	$p < 0.05^{*}$

3D Discount/2D Discount	1.12	$p < 0.05^{*}$
3D Brand/2D Discount	1.38	$p < 0.05^{*}$
Pleasure		
Product display		$p > 0.05$
Arousal		
3D Color/2D Discount	0.87	$p < 0.05^{*}$
Perceived merchandise quality		
3D Color/2D Discount	1.63	$p < 0.05^{*}$
3D Brand/2D Discount	1.13	$p < 0.05^{*}$
3D Color/2D Brand	1.09	$p = 0.053$

Hypotheses testing 4. Mediation analysis

Sobel test (1982) was used to test the mediation analysis. Sobel test showed that flow ($z = -2.35$, $p<0.05$) and perceived merchandise quality ($z = -2.85$, $p< 0.01$) mediate the relations between six different product display methods and consumer behavioral outcomes such as satisfaction, time spent, and patronage intentions. However, the mediation was partial because product display methods were directly associated with consumer cognitive, emotional, and behavioral outcomes. Thus, hypotheses 4 were partially supported.

Discussion and Conclusion

Discussion and Implications

The results showed that this study partially supported the S-O-R and flow theories. For example, 3D and 2D interfaces showed significant differences on flow, perceived merchandise quality, satisfaction, time spent, and patronage intentions. Also, product display methods based on color, discount, and brand in both 3D and 2D interfaces showed similar results. However, they did not have significant differences on consumers' emotional states: pleasure and arousal. Emotional states did not mediate the relationship between product display methods and consumer responses. This finding is contrary to the Wu et al. (2013) study because the authors found that product display methods based on color, style, and texture had significant differences on consumers' emotional states. Though the 3D interface contains more rich and multi-sensory elements than the 2D interface, it fails to provide consumers with a richer, more impactful emotional experience than the 2D interface. This might be because consumer might concentrate more on examining apparel items rather than focusing on the rich, multi-sensory attributes of the 3D interface. This finding confirms the finding from the Noort et al. (2012) study, that is consumers focus more on product-related information than the surface characteristics of websites when they experience flow. My findings showed that product display methods showed significant differences on consumers' cognitive states: flow and perceived merchandise quality. Perceived merchandise quality and flow marginally mediated the relationship between product display methods and consumers' responses.

This study also marginally supported the flow theory. For example, both 3D and 2D interfaces have significant differences on flow. Flow also impacted the relationship between the product display methods based on color, discount, and brand and consumers' responses. This finding confirms the findings of the Liu et al. (2016), Geo and Bai (2014), Animesh et al. (2011), and Hoffman and Novak (2000) studies.

Findings from my study showed that the 3D interface created higher flow, perceived merchandise quality, satisfaction, time spent, and patronage intentions compared to the 2D interface. The 3D interface allows consumers to walk around the store, which was designed using Mockshop software. They have an opportunity to come closer to an apparel item, which provides them with a richer, sensory experiences. On the other hand, the 2D interface presents static images of apparel items. Therefore, it does not provide consumers with more information about a product compared to the 3D interface. This finding conforms to the previous study by Park et al. (2005). As stated by Park et al. (2005), 3D product movement allows consumers to carefully examine the product, which reduces perceived risk.

My study implies that retailers could get benefits and increase their sales using 3D interfaces instead of 2D interfaces. It did not find any negative effects of the 3D interface on flow, perceived merchandise quality, satisfaction, time spent, and patronage intentions. Therefore, retailers could implement the 3D interface with product coordination in their shopping site. Furthermore, retailers could professionally present 3D features such as virtual try on, virtual mirror, 3D rotation, 3D videos, spatial distribution of information, haptic feedback, and avatar in their existing 2D websites.

Additionally, my study investigates the effects of product coordination display methods based on color, discount, and brand. It will provide retailers with a better understanding of how they will arrange space in an apparel store based on coordination. The findings showed that the color-coordinated display created higher flow, satisfaction, time spent, purchase intentions, and perceived merchandise quality than the discount-coordinated display. Also, the color-coordinated display marginally showed better perceived merchandise quality than the brand-coordinated display. These findings confirm the findings of the Wu et al. (2013) study, which also found that consumers preferred color-coordinated display over style- and texture- coordinated display. However, participants spent more time in style-coordinated display compared to color- and texture-coordinated display. Moreover, the importance of the color-coordinated display is also illustrated in the Kim et al. (2017) study. As noted by Kim et al. (2017), color presents additional information when consumers make their decisions. They argue that it is difficult for consumers to make their decisions when products are presented with different colors. The color-coordinated display will help consumers to attenuate the "compromise effect", meaning that they do not face any difficulty in choosing products. Also, color-coordinated display helps consumers to deeply absorb the information because it creates higher flow when compared to discount-coordinated display method. In the case of discount coordinated store, products of different colors are presented together, which might create difficulty for consumers in making their decisions.

However, the comparisons between 3D color and 3D brand, 3D discount and 3D brand, and 3D color and 3D discount did not show significant differences on consumers' responses, flow, and perceived merchandise quality. Also, the results are similar in the

case of the 2D interface. This might be because although products are coordinated based on color, discount, and brand, they are presented in the same interface: 3D and 2D. This could suggest that the interface has a stronger effect than the product coordination display on consumers' responses.

The implication of this study is that online retailers could present information based on similar color along with models, so that consumers can find visual harmony, which influences their flow experience, perceived merchandise quality, satisfaction, time spent, and patronage intentions. My finding showed that the 3D interface creates higher consumer preferences compared to the 2D interface. Therefore, the color-coordinated display in the 3D interface could provide consumers to process more information, which helps them to carefully evaluate the products. Also, along with the product presentation based on color, online retailers could provide virtualization technology, interactive medium, and zooming technology to enhance consumers' cognitive and behavioral outcomes.

The least preferable display method is product coordination display based on discount in the 2D interface. The findings showed that consumers would not like discount related displays during their shopping. Therefore, the implications of this finding are that retailers should take caution when implementing discount related displays to increase their sales or consumer satisfaction. This study conforms to the previous studies, Blattberg & Nesling (1990) and Grewal et al. (1998). As noted by Grewal et al. (1998), "perceptions of quality can be explained using self-perception theory, one type of attribution theory which describes how consumers explain events. If a consumer

purchases a product on discount they often "attribute" the fact that it was on discount because it is a poorer quality product (Dodson et al., 1978)" (p.7).

Limitations and future research

One of the important limitations of this study is that the 2D interface is not highly interactive compared to real online shopping sites. For example, only apparel items are coordinated in the 2D interface based on color, discount, and brand. However, GAP or Forever 21 online sites provide many options to navigate apparel items such as online pathfinding assistance, search engine, site map, and guide bar at the top or bottom of the page. Therefore, future research could develop a more interactive 2D interface to compare it with 3D interface.

Another important limitation of this study is that only undergraduate female consumers were chosen. Also, only female apparel items were selected for this study. Future research should include more diverse populations and apparel items to strengthen the generalizability of this study.

Also, this study did not examine the moderating role of personality traits such as fashion involvement, utilitarian and hedonic shopping orientation, need for cognition. Wu et al. (2013) showed that fashion involvement moderates the relationship between product display methods and consumers' responses. However, they did not find the significant moderating effect of utilitarian and hedonic searching behavior between product display methods and consumers' responses in the 3D interface. Although Wu et al. (2013) did not find a significant effect of utilitarian and hedonic searching behavior, it is reasonable to include utilitarian and hedonic searching behavior as a moderator

because my study compared between 3D and 2D interfaces. As noted by Kim & Forsythe (2007), 2D is more goal-directed. On the other hand, 3D virtualization technology is more hedonic oriented. Therefore, future research should analyze whether utilitarian and hedonic searching will moderate the relationship between product display methods based on color, discount, and brand on consumers' responses. Furthermore, the moderating role of the need for cognition can be analyzed in future studies. The need for cognition classifies into two types: High and low need for cognition (Cacioppo et al., 1984). Sicillia et al. (2005) state that consumers with a high need for cognition engage in effortful processing. On the other hand, consumers with a low need for cognition engages in effortless processing. They always look for emotional aspects to process the information.

Another important limitation regarding perceptual state of this study is that the researcher only investigated the effects of product display methods on unidimensional flow. Therefore, future research needs to measure the effects of product display methods on multidimensional flow. The multidimensional flow consists of enjoyment, concentration, control, and challenge (Hausman & Siekpe, 2009).

Moreover, future research could focus on consumers' response such as impulsive buying behavior. Sharma et al. (2010) define impulse buying "as a sudden, hedonically complex purchase behavior in which the rapidity of the impulse purchase precludes any thoughtful, deliberate consideration of alternative or future implications" (p.277). Therefore, future research can be conducted to understand which product display methods would create higher impulsive buying behavior compared to other product display methods.

This study measures perceived merchandise quality and flow as cognitive states and pleasure and arousal as affective states. Cognitive states such as perceived diagnosticity and perceived usefulness can also be considered. Other affective states such as shopping enjoyment and brand experience can also be considered. Furthermore, future studies can measure the usability directly. Prior studies showed that perceived usefulness and perceived ease of use are higher for the 2D interface than the 3D interface (Viscinescu et al., 2015). Therefore, future studies can analyze whether coordination of products would enhance higher usefulness and usability in 3D interface compared to the 2D interface.

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Appendix

Questionnaire

Greetings!

Thank you for participating in this research. Please read the consent form before completing the questionnaire. Your responses are voluntary and anonymous.

Consent form

Fashion product display: An experiment with 3D/2D interfaces and product coordination based on discount, color, and brand

You are invited to be in a research study of retail environments and products displays. You have been asked to participate due to your age (18-30) and female consumer. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Ahmad Saquib Sina (graduate student) in the Department of Design, Housing, and Apparel at the University of Minnesota.

Background Information

The purpose of this research is to determine consumers' responses towards different retail displays and how individual differences may predict a preference for one display over another.

Procedures:
If you agree to be in this study, you will fill out an online questionnaire. The questionnaire will ask: 1) demographic questions, 2) questions about your shopping behaviors, 3) view a product display, 4) questions about your reaction to the product display. Completion of the survey should take 15-20 minutes.

Risks and Benefits of being in the Study
The research involves no more than minimal risk. The probability and magnitude of harm or discomfort are not greater in and of themselves than those ordinarily encountered in the daily life. The benefits are that you will be exposed to new visual merchandising and product display ideas.

Confidentiality:
The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only the researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researcher conducting this study is Ahmad Saquib Sina. You may ask me any questions you may have now. If you have any questions later, you are encouraged to contact me at:

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346 McNeal Hall

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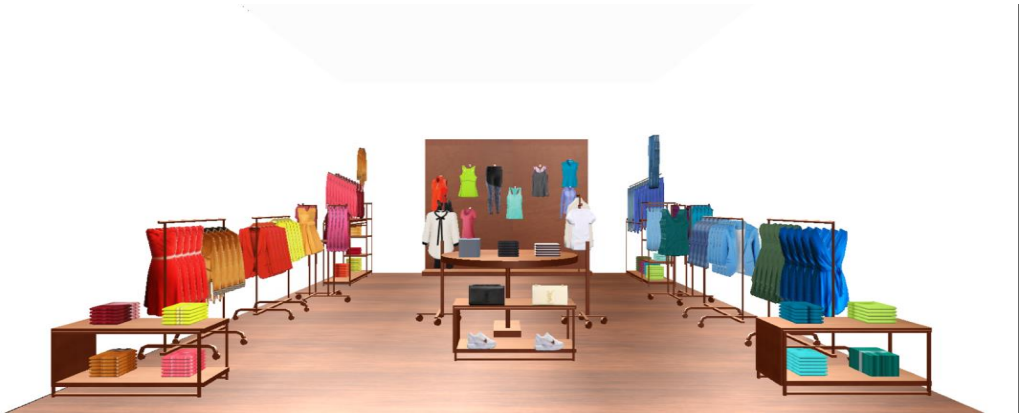
If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Research Subjects'

Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

Part I

Keep this scenario in mind as you complete the survey….



Please indicate how much you agree or disagree with the following statement:

Please observe the following picture of the apparel product display. Keep in mind **only the apparel products are for sale.**

Imagine you are shopping for an apparel item for yourself or a female friend. Imagine this apparel product display is the first display you see upon encountering a retailer. Please note the attractiveness of the display and how this display would help you complete your shopping.

Item	Strongly disagree			agree			Strongly
This visual product display is coordinated based on brand of the apparel products	1	2	3	4	5	6	7
This visual product display is coordinated based on price discount of the apparel products	1	2	3	4	5	6	7
This visual product display is coordinated based on color of the apparel products	1	2	3	4	5	6	7

Part II

The second part of this questionnaire will ask you questions about the product display you have just viewed. Please refer back to the picture of the product display if needed.

Please read the adjectives on each side of the boxes. Based on these adjectives, circle the number that indicates how you felt while viewing the product display.

For example:

Happy 1 2 3 4 5 6 7 Sad

If the product display made you feel very happy, you would circle 1. If the product display made you feel equally happy and sad, you would circle 4. If the product display made you very sad, you would circle 7.

Contended	1	2	3	4	5	6	7	Depressed
Happy	1	2	3	4	5	6	7	Unhappy
Satisfied	1	2	3	4	5	6	7	Unsatisfied
Pleased	1	2	3	4	5	6	7	Annoyed
Relaxed	1	2	3	4	5	6	7	Bored
Important	1	2	3	4	5	6	7	Insignificant
Free	1	2	3	4	5	6	7	Restricted
Hopeful	1	2	3	4	5	6	7	Despairing
Stimulated	1	2	3	4	5	6	7	Relaxed
Excited	1	2	3	4	5	6	7	Calm
Jittery	1	2	3	4	5	6	7	Dull
Aroused	1	2	3	4	5	6	7	Unaroused
Frenzied	1	2	3	4	5	6	7	Sluggish
Overcrowded	1	2	3	4	5	6	7	Uncrowded
Wide awake	1	2	3	4	5	6	7	Sleepy

Part III

The word “flow” is used to describe a state of mind that is sometimes experienced by people who are deeply involved in an activity. One example of flow is the case where a computer gamer is deeply involved in a game and achieves a state of mind where nothing else matters but the game. In other words, he or she is completely and totally immersed in it. Some people report this state of mind when engaging in various activities such as

watching movies, reading novels, browsing the Web, or working. Activities that lead to flow completely captivate a person for some period of time. When one is in flow, time may seem to stand still, and nothing else seems to matter. Flow may not last for a long time on any particular occasion, but it may come and go over time. Flow has been described as an intrinsically enjoyable experience. Please answer the following questions regarding your experience on the visual store:

Item	**Strongly disagree**						**Strongly agree**
When visiting the visual store, I experienced flow at some point	1	2	3	4	5	6	7
I felt I was in flow during some parts of the visual store.	1	2	3	4	5	6	7
I did not experience any flow during any part of the visual store	1	2	3	4	5	6	7
I experienced flow during my visit to the visual store	1	2	3	4	5	6	7

Part IV

The fourth part of this questionnaire will ask you questions about your shopping behavior

Please indicate how much you agree or disagree with the following statements:

How satisfied are you with the visual store?	1(very dissatisfied)	2	3	4	5	6	7 (very satisfied)
How well does the visual store match your expectations?	1 (not at all)	2	3	4	5	6	7 (completely)
Imagine a perfect visual store. How close to this ideal is what you just viewed?	1 (not at all)	2	3	4	5	6	7 (very close)

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree					Strongly agree
The likelihood that I would shop in this store is high	1	2	3.	4.	5	6 7
I would be willing to buy gifts at this store	1.	2.	3.	4.	5	6 7
I would be willing to recommend this store to my friends	1.	2.	3.	4.	5	6 7

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree					Strongly agree
This visual store offers high quality items	1	2	3.	4.	5	6 7
The items in the visual store have high workmanship	1.	2.	3.	4.	5	6 7

Part V

This part of this questionnaire will ask for demographic information.

1. Please indicate your age: _____ years

2. Please indicate your sex: □Female □Male

3. Please indicate your annual household income: □ Under $20,000

□ $20,000-$39,999 □ $40,000-$59,999 □ $60,000-$79,999 □ $80,000-$99,999 □ $100,000 or more

4. Academic major: _____

5. Have you participated in this research before? □ No □ Yes

6. Are you an undergraduate student of the Department of Design, Housing and Apparel

□ No □ Yes

List of figures

Figure 1

Product-coordinated display based on Color in the 3D interface

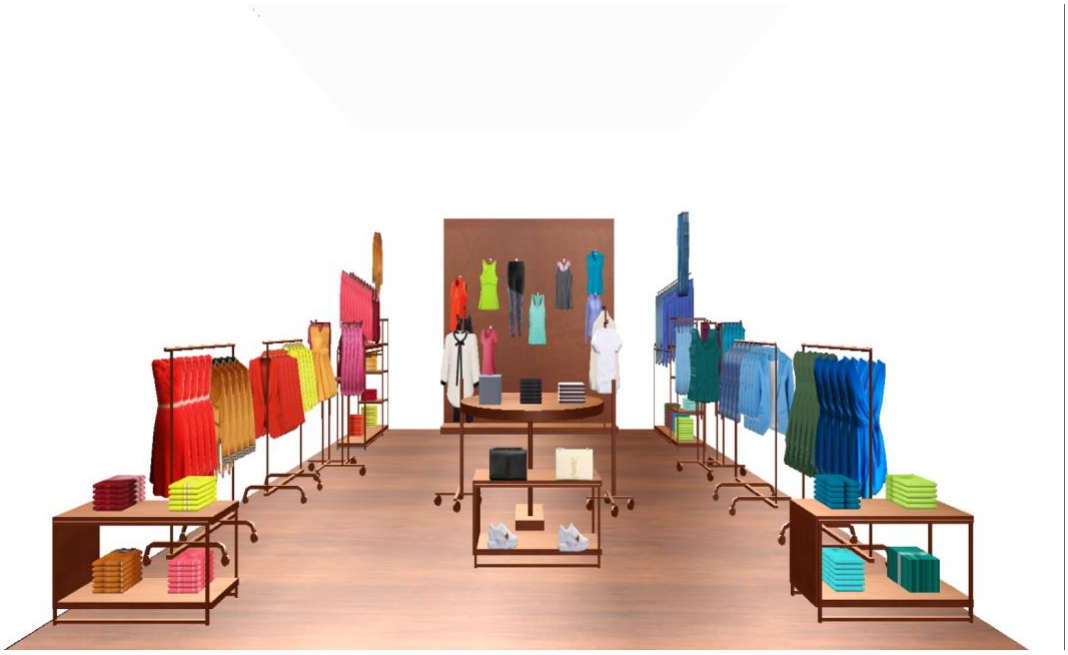


Figure 2

Product coordinated display based on Discount in the 3D interface

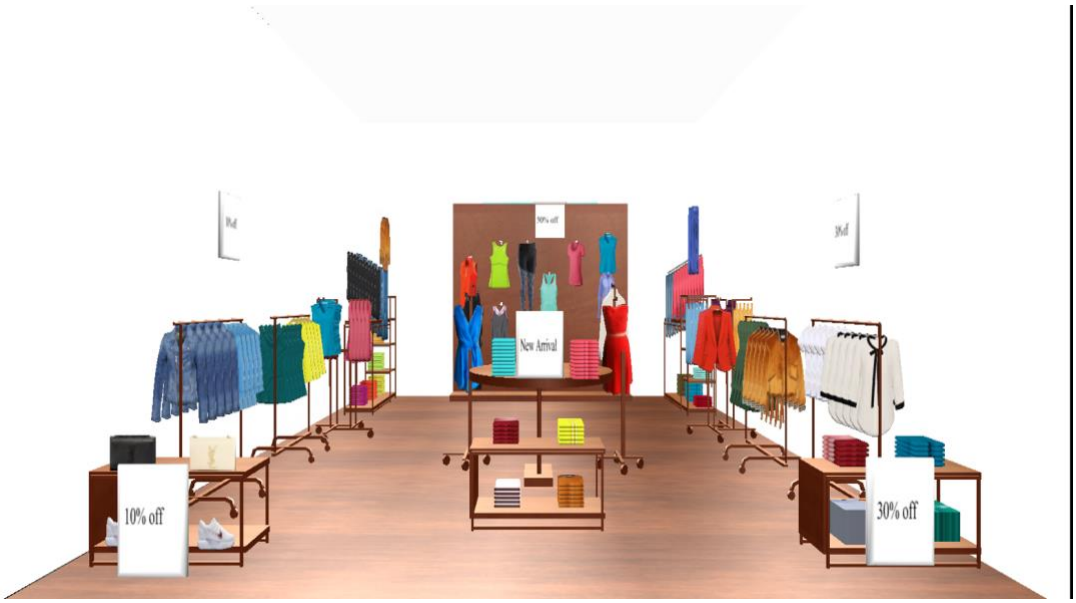


Figure 3

Product-coordinated display based on Brand in the 3D interface

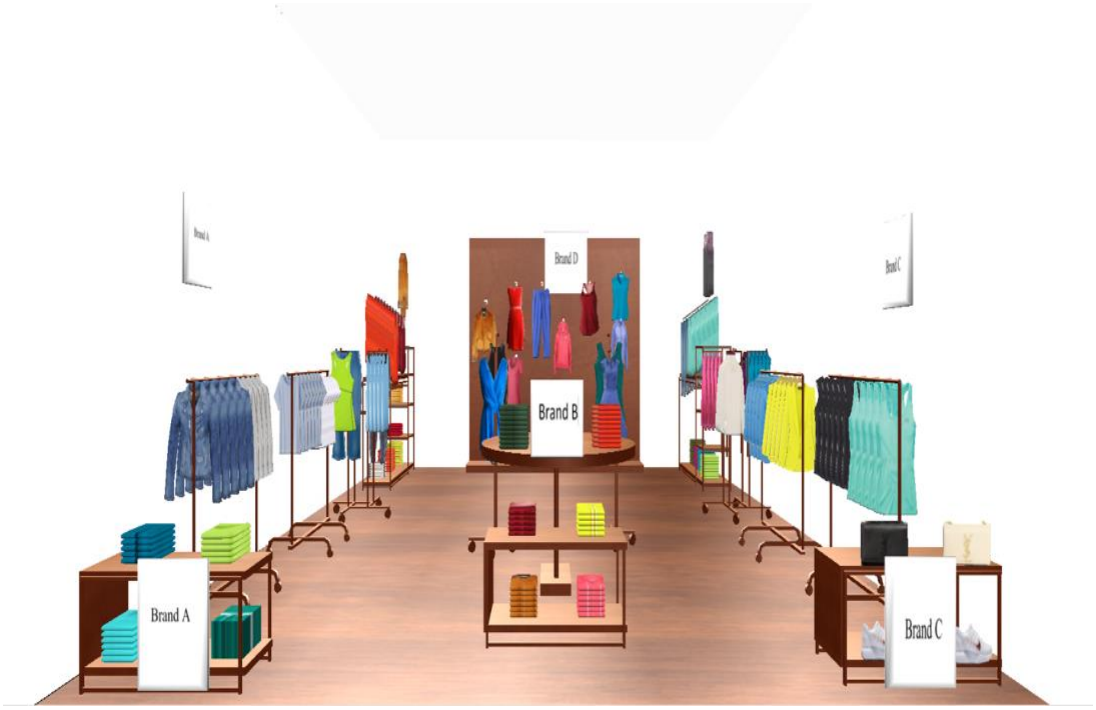


Figure 4

Product-coordinated display based on color in the 2D interface

Neutral color

Mix color

Cool color





Figure 5

Product-coordinated display based on Discount





New Arrival








50% off

30% off

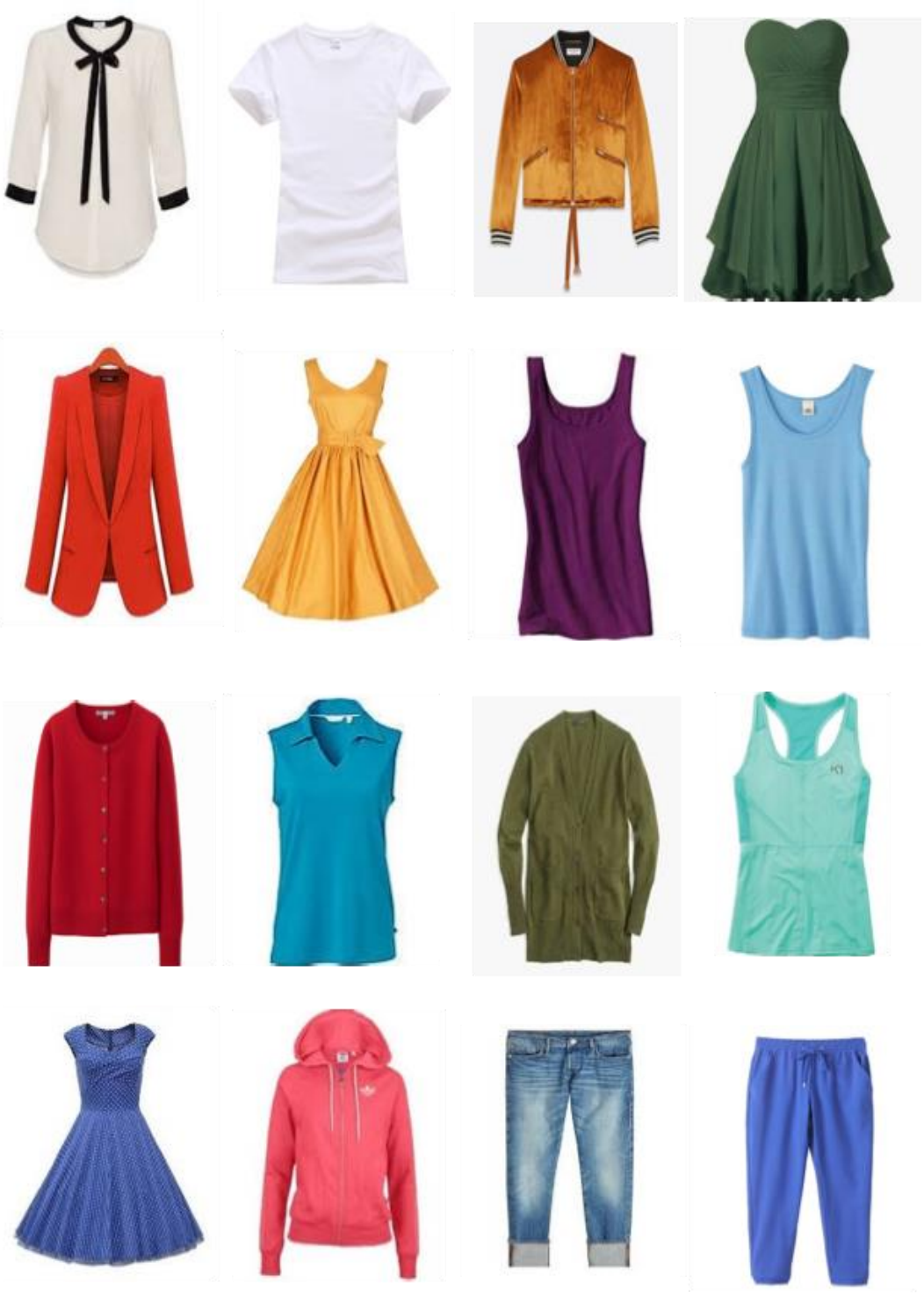


Figure 6

Product-coordinated display based on Brand in the 2D interface







Brand C




ONTINVA

Brand D